

8 at least one electrode coupled to the measurement mass, wherein the at least one electrode is
9 patterned to reduce stiction during sensor operation.

1 ~~14~~ 2. The apparatus of claim ~~1~~ ¹³ wherein the environmental condition is acceleration.

1 ~~15~~ 3. The apparatus of claim ~~1~~ ¹³, wherein the at least one cap wafer further comprises a top cap
2 wafer and a bottom cap wafer that form a cavity, the measurement mass being housed at least
3 partially within the cavity.

1 ~~16~~ 4. The apparatus of claim ~~3~~ ¹⁵, wherein the measurement mass further includes a passage for
2 venting air from the cavity in the housing.

1 ~~17~~ 5. The apparatus of claim ~~3~~ ¹⁵, wherein the passage comprises an approximately V-shaped
2 groove in the measurement mass.

1 ~~18~~ 6. The apparatus of claim ~~1~~ ¹³, wherein the electrode pattern includes one or more cavities for
2 reducing stiction between the plurality of bumpers and the at least one electrode.

1 ~~19~~ 7. The apparatus of claim ~~1~~ ¹³, wherein the electrode pattern includes one or more
2 reduced-thickness
3 recesses for reducing stiction between the plurality of bumpers and the at least one electrode

1 ~~20~~ 8. The apparatus of claim ~~1~~ ¹³, wherein the electrode pattern is selected from a group consisting
2 of
3 i) a plurality of squares;
4 ii) a plurality of circles;
5 iii) a plurality of concentric circles;
6 iv) a plurality of rectangles; and
7 v) a series of geometrically arranged pie-shaped segments.

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1 The apparatus of claim 4, wherein the first plurality of bumpers is arranged in the shape of
2 circles and ridges; and wherein the second plurality of bumpers is arranged in at least the shape
3 of circles and ridges.

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1 A method of fabricating a sensor element, comprising:
2 fabricating a measurement mass for detecting acceleration using a first process, the measurement
3 mass including:

- 4 a mass housing having a cavity, and a spring mass assembly positioned within the cavity;
- 5 fabricating a top cap wafer using the first process;
- 6 fabricating a bottom cap wafer using the first process;
- 7 bonding the top cap wafer to a side of the measurement mass using a bonding process;
- 8 bonding the bottom cap wafer to another side of the measurement mass using the bonding
9 process; and
- 10 making one or more dicing cuts at predetermined locations on the sensor element.

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1 The method of claim 10, wherein fabricating the measurement mass further includes
2 fabricating a passage for venting air from the cavity.

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1 The method of claim 11, wherein the passage comprises a V-shaped groove.

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1 The method of claim 11, wherein the dicing cuts penetrate through the top cap wafer, the
2 bottom cap wafer, and at least partially through the measurement mass.

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1 The method of claim 13 further comprising a second process to expose the passage within
2 the measurement mass; wherein air is removed from the cavity through the passage to create a
3 low pressure environment in the cavity; and wherein the passage is sealed to maintain the low
4 pressure environment within the cavity.

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1 The method of claim 14, further comprising packaging the sensor element in a sensor
2 housing and using a vacuum process to remove substantially all air from the sensor housing during
3 packaging to create a low pressure environment within the sensor housing; wherein air is removed

4 from the accelerometer through the passage during the vacuum process; and wherein the sensor
5 housing is sealed to maintain the low pressure environment.

1 ~~28~~ 16. The method of claim ~~10~~ ²², wherein the top cap wafer includes a balanced metal pattern on
2 an upper surface of the top cap wafer.
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1 ~~29~~ 17. The method of claim ~~10~~ ²², wherein the bottom cap wafer includes a balanced metal pattern
2 on a lower surface of the bottom cap wafer.
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1 ~~30~~ 18. The method of claim ~~10~~ ²², wherein the spring mass assembly comprises springs; and wherein
2 the springs include an etch-stop layer on one or more surfaces of the springs.
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1 ~~31~~ 19. The method of claim ~~10~~ ²², wherein the measurement mass includes one or more mass
2 contact pads; and wherein the dicing cut is made through the top cap wafer to expose the mass
3 contact pads on the measurement mass.

1 ~~32~~ 20. The method of claim ~~10~~ ²², wherein the top cap wafer includes an electrode located on a lower
2 surface of the top cap wafer; wherein the electrode includes one or more electrical leads; and
3 wherein the dicing cuts isolate the electrical leads.

1 ~~33~~ 21. The method of claim ~~10~~ ²², wherein the measurement mass includes one or more mass
2 contact pads; and wherein the dicing cut is made through the bottom cap wafer to expose the mass
3 contact pad on the measurement mass.

1 ~~34~~ 22. The method of claim ~~10~~ ²², wherein the bottom cap wafer includes an electrode located on an
2 upper surface of the bottom cap wafer; wherein the electrode includes one or more electrical leads;
3 and wherein the dicing cuts isolate the electrical leads.


1 ³⁵
~~23.~~ The method of claim ²²10, wherein the measurement mass includes one or more mass
2 contact pads and the dicing cuts are made:
3 through the top cap wafer to expose the mass contact pads on the measurement mass; and
4 through the bottom cap wafer to expose the mass contact pads on the measurement mass.

1 ³⁶
2 ^{24.} The method of claim ²³10, wherein the dicing cuts are made through the top cap wafer and
3 the bottom cap wafer and into the measurement mass, stopping at a predetermined distance from
the passage within the measurement mass.

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2 ^{25.} The method of claim ³⁶24, wherein the top cap wafer, the bottom cap wafer, and the
3 measurement mass include electrodes; wherein the electrodes include one or more electrical leads;
and wherein the dicing cuts isolate the electrical leads.

Respectfully submitted,

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